

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

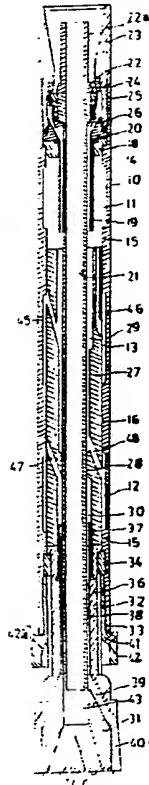
(51) International Patent Classification 4 :	A1	(11) International Publication Number: WO 88/ 03220
E21B 4/14		(43) International Publication Date: 5 May 1988 (05.05.88)

(21) International Application Number: PCT/AU87/00362	US.
(22) International Filing Date: 26 October 1987 (26.10.87)	Published <i>With international search report.</i>
(31) Priority Application Number: PH 8685	
(32) Priority Date: 24 October 1986 (24.10.86)	
(33) Priority Country: AU	
(71)(72) Applicant and Inventor: LISTER, William [AU/AU]; 36 Rabaul Street, Moorooka, QLD 4105 (AU).	
(74) Agent: GRANT ADAMS & COMPANY; 333 Adelaide Street, G.P.O. Box 1413, Brisbane, QLD 4000 (AU).	
(81) Designated States: AT (European patent), AU, BE (Eu- ropean patent), CH (European patent), DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European pa- tent), NL (European patent), SE (European patent),	

(54) Title: A PNEUMATIC PERCUSSION HAMMER

(57) Abstract

A pneumatic percussion hammer casing (10), a top sub (23) connected to the outer tube of a double tube drill stem, an air feed pipe (19) extending from the top sub (23) co-axially into the casing and co-axially about an air outflow pipe (21) connected at its upper end to the inner drill stem tube, its lower end slidable in an air passage (38) through bit (31) the shank of which (32) is slidable in a driver sub (33) at the lower casing end and topped by an anvil (35), a passage (43) having ducts (39, 44) extending to the exterior of the bit (31). A tubular piston (27), slidable in the casing (10) co-axially about the air outflow pipe (21) engages, when brought down onto the anvil (35), tube (37) rising from passage (38) through the bit, shank and anvil. Annular chambers (11, 12, 13) are formed within the casing (10) and the axial passage of the piston is divided into upper and lower passages (29, 30). Piston (27) is formed with ports (45, 46, 47, 48) to act as a valve for effecting reciprocating movement, impacting the anvil (35) on its downstrokes, but if the casing (10) is raised to lift the bit (31) from its work face, the anvil (35) and piston (27) descent so that the hammer is in a state of balance and automatically ceases operation.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT Austria	FR France	ML Mali
AU Australia	GA Gabon	MR Mauritania
BB Barbados	GB United Kingdom	MW Malawi
BE Belgium	HU Hungary	NL Netherlands
BG Bulgaria	IT Italy	NO Norway
BJ Benin	JP Japan	RO Romania
BR Brazil	KP Democratic People's Republic of Korea	SD Sudan
CF Central African Republic	KR Republic of Korea	SE Sweden
CG Congo	LI Liechtenstein	SN Senegal
CH Switzerland	LK Sri Lanka	SU Soviet Union
CM Cameroon	LU Luxembourg	TD Chad
DE Germany, Federal Republic of	MC Monaco	TG Togo
DK Denmark	MG Madagascar	US United States of America
FI Finland		

WO 88/03220

PCT/AU87/00362

-1-

Title: "A PNEUMATIC PERCUSSION HAMMER"

BACKGROUND OF THE INVENTION

(1) Field of the Invention

THIS INVENTION relates to a pneumatic
5 percussion hammer.

(2) Prior Art

Pneumatic percussion hammers are well-known
and widely used in rock drilling, such a hammer being
described and illustrated in the specification of my
10 Australian Patent No. 493847. Although hammers accord-
ing to this Patent have been found to be very efficient
in operation, they are not able to provide uncontamin-
ated core samples as the rock fragments carried by the
15 flow of air up the bore hold, outside the hammer and the
drill tube onto which the hammer is screwed, will be
likely to detach fragments from the sides of the bore
hole and the air flow will carry these as well as frag-
ments from the bottom of the hole.

SUMMARY OF THE PRESENT INVENTION

20 The general object of the present invention is
to provide a pneumatic percussion hammer which will
overcome this disadvantage.

The invention resides broadly in a pneumatic
percussion hammer for rock drilling including:

25 a tubular casing;

a top sub at the top of the casing for
connection to, and to receive air under pressure from,
the outer tube of a double tube drill stem;

30 an air feed pipe from the top sub extending
co-axially into the casing;

an air outflow pipe for connection at the
top to the inner tube of the drill stem and passing co-
axially through the air feed pipe;

35 a bit, its shank mounted for limited slid-
able movement in the lower end of the casing;

WO 88/03220

PCT/AU87/00362

-2-

an anvil on the bit shank;
a bit air passage through the anvil, shank
and bit, and ducted to the exterior of the bit, the
lower end of the air outflow pipe being slidably engaged
5 in the lower part of this passage and communicating,
through ducts, to the bottom of the bit;
a sliding seal tube, its lower end secured
in the upper part of the bit air passage, and extending
above the anvil and co-axially about the air outflow
10 pipe;
a piston disposed co-axially about the air
outflow tube and slidable in the casing to strike the
anvil on its down-stroke, the bore of the piston being
restricted at an intermediate position for close
15 slidable engagement with the air outflow tube and to
divide the axial passage of the piston into an upper
axial passage which is slidably engaged with the air
feed tube and a lower axial passage for slidably engage-
ment, when the piston is on its downstroke, with the
20 sliding seal tube;
a top pressure chamber in the casing about
and above the top of the piston;
a bottom pressure chamber in the casing
about and below the piston;
25 a central chamber in the casing about an
intermediate part of the piston; and
pressure ports in the piston for directing
air under pressure from the upper axial passage of the
piston to the top pressure chamber when the piston is in
30 raised position, and to the bottom pressure chamber when
the piston is in lowered position, and exhaust ports in
the piston for conducting air, when the piston is
lowered, from the central chamber to the top pressure
chamber.
35 Other features of the invention will become

WO 88/03220

PCT/AU87/00362

-3-

apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that a preferred embodiment of the invention may be readily understood and carried into practical effect, reference is now made to the accompanying drawings, wherein:

FIG. 1 is a sectional view of a percussion hammer according to the invention, its piston in fully raised position;

10 FIG. 2 shows in section the hammer with its piston driven down onto the anvil; and

FIG. 3 is a similar view of the hammer lifted from the work face.

DETAILED DESCRIPTION OF THE PREFERRED

15 EMBODIMENT

This percussion hammer includes a cylindrical tubular casing 10, of which each end part of the bore is enlarged and threaded. Two further enlargements of the bore define a top pressure chamber 11 and a bottom pressure chamber 12, and a central bore enlargement defines a central chamber 13. The lesser diameter parts between these chambers define a top shoulder 14, a bottom shoulder 15 and top and bottom piston bearings 16 and 17.

25 A piston stop ring 18 engaged with the top shoulder 14 has a seating for the enlarged top of air feed tube 19 co-axial with the casing 10 and held in place by a retaining ring 20. This retaining ring 20 is formed with a seating for the enlarged top of an air 30 outflow tube 21 passing co-axially through, and spaced from, the air feed tube 19. An air inlet fitting 22 bears on the enlarged top of the air outflow tube 21, and is itself held in place by a top sub 23 screwed into the threaded upper end of the casing 10. The top sub 35 may be engaged with a double-tube drill stem (not shown)

WO 88/03220

PCT/AU87/00362

-4-

of a rock drilling assembly, the central air outflow tube (not shown) of a rock drilling assembly, the central air outflow tube (not shown) of the drill stem being connected to the central tubular part 22a of the 5 air inlet fitting 22. Air passing under pressure down through the outer tube of the drill stem may pass through air passages 24 in the base of the air inlet fitting 22, against the action of a spring-loaded check valve 25, and by way of air passages 26 through the 10 retaining ring 20 into the top of the air feed tube 19.

A piston 27 is slidable in the top and bottom piston bearings 16 and 17 and is axially bored, an annular shoulder 28 within the bore, and which fits closely to the air outflow tube 21, dividing the piston 15 bore into an upper axial passage 29 and a lower axial passage 30. The top part of the upper axial passage 29 is enlarged in diameter to receive closely but slidably the air feed tube 19.

A bit 31 has its shank 32 slidably engaged in 20 a driver sub 33 screwed into the threaded lower end of the casing 10 to hold a split anvil stop ring 34 against the bottom shoulder 15, this stop ring limiting the downward movement of the enlarged upper end or anvil 35 of the bit shank 32. The lower part 36 of the bit shank 25 is splined for slidable, but non-rotatable movement, in a correspondingly grooved bore of the driver sub 33.

A sliding seal tube 37 has its lower end fixed in the top of an air passage 38 which is formed axially through the bit shank 32 and communicates with several 30 air ducts 39 through the bit and leading into flutes 40 down the sides of the bit. Ducts 41, lead obliquely upwards and outwards through a collar 42 about the lower end of the driver sub 33 and which is of greater diameter than the tubular casing 10. The ducts 41 alter- 35 nate with small cutter teeth 42a about the top periphery

WO 88/03220

PCT/AU87/00362

-5-

of the collar 42.

The air outflow tube 21 extends co-axially down through the air passage 38 of the bit shank and has its lower end closely but slidably engaged in an axial 5 passage 43 in the bit, this passage 43 leading by way of several oblique air ducts 44 to the bottom of the bit.

Assuming the piston 27 is initially raised, as shown in FIG. 1, its upper end close to the piston stop ring 18, then air under pressure passing through 10 the feed tube 19 enters the upper axial passage 29 of the piston and thence passes through an oblique pressure port 45 into the top pressure chamber 11 to drive the piston down into the anvil 35, as shown in FIG. 2, driving the bit 31 on the work face.

15 Air under pressure in the top pressure chamber 11 can then pass into the central chamber 13 by way of a top exhaust port 46 in the piston, this port being closed when the piston is rised to its previous position shown in FIG. 1.

20 From the central chamber 13 the air under pressure can pass through a central chamber exhaust port 47 in the piston to the piston's lower axial passage 30, through the sliding seal tube 37 and the axial passage 38 of the bit shank, and through the air ducts 39 and 25 flutes 40. Rock fragments are carried by the air flow into the bit by way of the air ducts 44, and thence up through the air outflow tube 21.

When the piston 27 has been brought down on the anvil 35, as described, air under pressure in the 30 upper axial passage 29 of the piston is conducted through a pressure port 48 in the piston to the bottom pressure chamber 12 to drive the piston upwards, the port 48 being quickly closed on entering the lower piston bearing 17. When the piston rises clear of the 35 sliding seal tube 37, air under pressure in the bottom

WO 88/03220

PCT/AU87/00362

-6-

- pressure chamber 12 can expand into the lower axial passage 30 of the piston and thence through the oblique port 47 to the central chamber 13. With the up-stroke of the piston, air is compressed between it and the 5 piston stop ring 18 to absorb shock and give reaction air thrust before the pressure port 45 is opened to cause the piston to be driven down again.

It will be seen that while the hammer is in operation, the rock fragments produced are carried up 10 through the hammer in a strong up-flow of air, and are brought up to ground level through the double tube drill stem without contamination from higher levels of the hole drilled.

As soon as the casing 10 is lifted to bring 15 the bit 31 clear of the work face, the bit drops relative to the casing, as shown in FIG. 3, until the anvil 35 rests on the anvil stop ring 34, the piston 27 coming to rest on the anvil. The hammer is then in a condition of air balance; but as soon as the casing is lowered to 20 bring the bit onto the work face, the hammer will immediately recommence operation.

In the event of the hammer being blocked in the hole, air may be introduced under pressure through the central tubular part 22a of the air inlet 25 fitting 22, to be expelled through the air ducts 44, up through the bit flutes 40 and through the passages 41 of the collar 42, to blow obstructing material up through the hole. If necessary, obstructing material may be cut through by rotating and lifting the hammer so that the 30 cutters 42a will break up the blockage.

WO 88/03220

PCT/AU87/00362

- 7 -

CLAIMS

1. A pneumatic percussion hammer for rock drilling including:
 - a tubular casing;
 - a top sub at the top of the casing for connection to, and to receive air under pressure from, the outer tube of a double tube drill stem;
 - an air feed pipe from the top sub extending co-axially into the casing;
 - an air outflow pipe for connection at the top to the inner tube of the drill stem and passing co-axially through the air feed pipe;
 - a bit, its shank mounted for limited sliable movement in the lower end of the casing;
 - an anvil on the bit shank;
 - a bit air passage through the anvil, shank and bit, slidably engaged on the lower end of the air outflow pipe and ducted to the exterior of the bit, the lower end of the air outflow pipe being slidably engaged in the lower part of the bit air passage and communicating through ducts to the bottom of the bit;
 - a sliding seal tube extending up from the upper part of the bit air passage and disposed co-axially about the air outflow pipe;
 - a piston disposed co-axially about the air outflow tube and slidable in the casing to strike the anvil on its down-stroke, the bore of the piston being restricted at an intermediate position for close slidable engagement with the air outflow tube and to divide the axial passage of the piston into an upper axial passage which is slidably engaged with the air feed tube and a lower axial passage for slidable engagement, when the piston is on its down-stroke, with the sliding seal tube;
 - a top pressure chamber in the casing about and above the top of the piston;

WO 88/03220

PCT/AU87/00362

-8-

a bottom pressure chamber in the casing about and below the piston;

a central chamber in the casing about an intermediate part of the piston;

pressure ports in the piston for directing air under pressure from the upper axial passage of the piston to the top pressure chamber when the piston is in raised position and to the bottom pressure chamber when the piston is in lowered position; and

exhaust ports in the piston for conducting air, when the piston is lowered, from the central chamber to the top pressure chamber.

2. A pneumatic percussion hammer according to Claim 1 wherein:

the piston, on descending to the anvil, when the bit is lifted clear of a work face, and the anvil is brought below normal operating position, brings the hammer to a condition of air balance, automatically discontinuing its operation.

3. A pneumatic percussion hammer according to either of the preceding claims wherein:

the bit shank is splined for limited slidable movement in a drive sub at the lower end of the casing; and

the drive sub, below the casing, is of greater diameter than the casing and provided with cutters for the purpose hereinbefore set out.

4. A pneumatic percussion hammer substantially as herein described with reference to the accompanying drawings.

WO 88/03220

PCT/AU87/00362

1/1

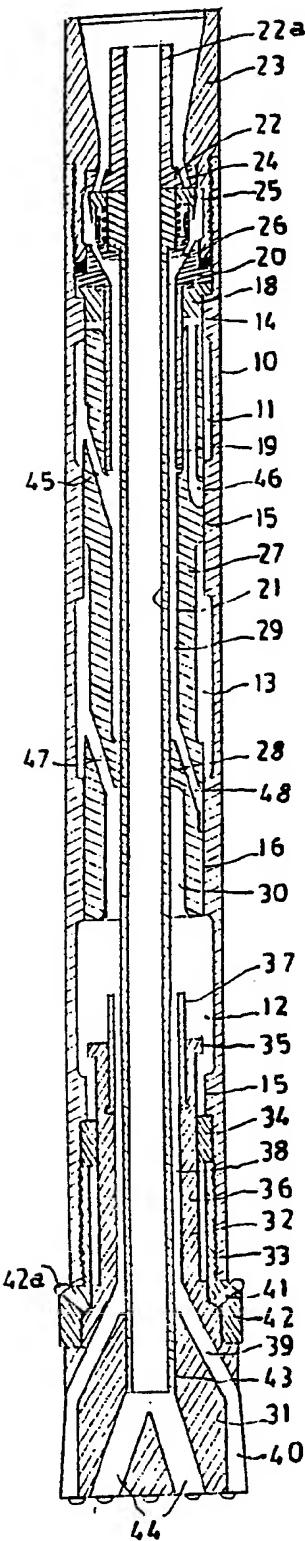


Fig. 1.

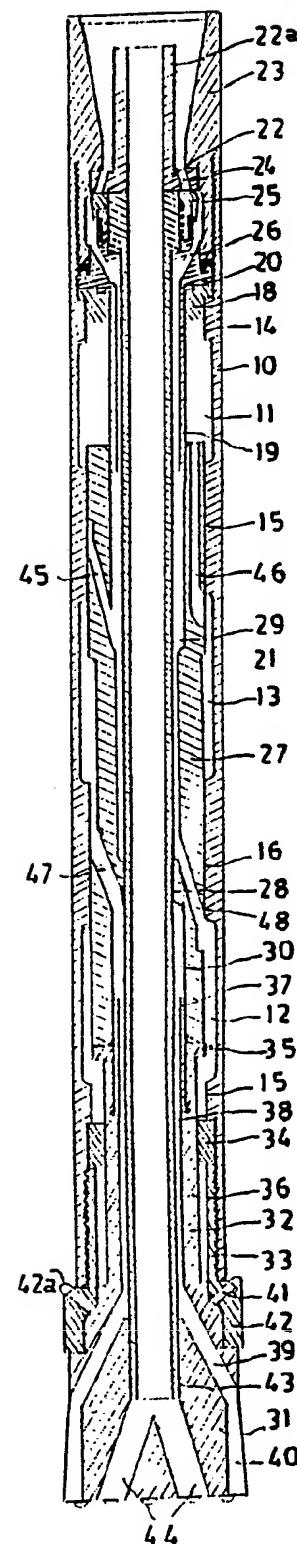


Fig. 2.

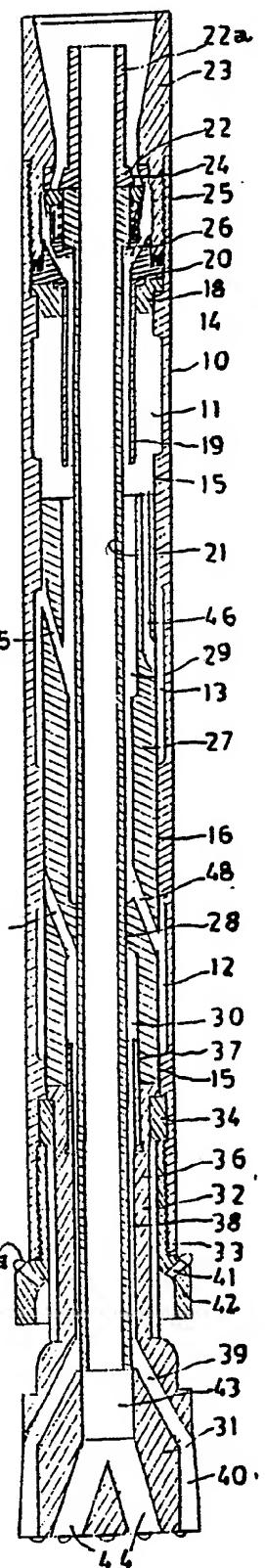


Fig. 3.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 87/00362

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl. 4 E21B 4/14

II. FIELDS SEARCHED

Minimum Documentation Searched *

Classification System	Classification Symbols
IPC	E21B 4/14, 1/06

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched *

AU : IPC as above + E21B 21/00, 21/12 (1975-87)

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages ***	Relevant to Claim No. *
P,A	AU,A, 52436/86 (DRESSER AUSTRALIA PTY LTD) 23 July 1987 (23.07.87)	(1-3)
A	AU,B, 70572/74 (482481) (BAKERDRILL, INC) 8 January 1976 (08.01.76)	(1-3)
A	WO,A, 85/04212 (ENNIS) 26 September 1985 (26.09.85)	(1-3)
P,A	EP,A, 0204243 (WEAVER & HURT LTD) 10 December 1986 (10.12.86)	(1-3)
A	US,A, 4321974 (KLEMM) 30 March 1982 (30.03.82)	(1-3)
A	US,A, 3524511 (KLEMM) 18 August 1970 (18.08.70)	(1,2)

* Special categories of cited documents: **
 "A" document defining the general state of the art which is not
 considered to be of particular relevance
 "E" earlier document but published on or after the international
 filing date
 "L" document which may throw doubts on priority claim(s) or
 which is cited to establish the publication date of another
 citation or other special reason (as specified)
 "O" document referring to an oral disclosure, use, exhibition or
 other means
 "P" document published prior to the international filing date but
 later than the priority date claimed

"T" later document published after the international filing date
 or priority date and not in conflict with the application but
 cited to understand the principle or theory underlying the
 invention
 "X" document of particular relevance: the claimed invention
 cannot be considered novel or cannot be considered to
 involve an inventive step
 "Y" document of particular relevance: the claimed invention
 cannot be considered to involve an inventive step when the
 document is combined with one or more other such docu-
 ments, such combination being obvious to a person skilled
 in the art.
 "Z" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

22 December 1987 (22.12.87)

Date of Mailing of this International Search Report

(21-01-88) 21 JANUARY 1988

International Searching Authority
Australian Patent Office

Signature of Authorized Officer

PWARD

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 87/00362

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document
Cited in Search
Report

Patent Family Members

US 4321974 DE 2854461

EP 0204243 AU 58052/86 GB 8514505 GB 8612767
GB 2175941

WO 8504212 AU 40654/85 BR 8505860 DK 5301/85
EP 156609 EP 174972 FI 854496
GB 8406957 GB 8527581 GB 2170841
NO 854473 US 4705118 ZA 8501945

AU 70572/74 CA 1002510 CA 1016932 CA 1016933
CA 1016935 CA 1022148 CA 1026314
GB 1461001 GB 1461002 GB 1461003
GB 1461004 GB 1461005 IN 142586
IN 142587 IN 142947 IN 143251
JP 50051002 US 3871486 US 3934662
US 3941196 US 3948588 US 3970335
ZA 7402740

END OF ANNEX